Contents

1.0 Purpose/Scope

This procedure provides a standardized method for the operation of the Holaday Model HI-3002 Broadband Exposure Meter. It should be used in conjunction with the ESH Standard 2.3.2 Radio Frequency and Microwaves (RF/Microwave) and IH SOP IH-99150 *Radiofrequency and Microwave Measurement Principles: Area Surveys.* .

The Holaday HI 3002 is used to measure radiofrequency and microwave fields in the wavelengths of:
- 0.5 MHz to 6000 MHz (500kHz to 6 GHz) electric field, and
- 0.5 to 300 MHz (500 kHz to 300 MHz) magnetic field.

This meter can be used to:
- Determine the need for area warning posting,
- Determine if inclusion in a medical surveillance program is required,
- Measure the effectiveness of engineering controls,
- Locate problem rf/microwave sources and leaks,
- Determine the need for additional personal monitoring, and
- Delineate controlled areas.

2.0 Responsibilities

2.1 Use of this SOP shall be limited to persons who act under the direction of a competent hazard assessor and who have demonstrated the competency to satisfactorily use the procedures and meter, as evidenced by experience and

training, to the satisfaction of their supervision or existing qualification criteria set by their organization.

2.2 Personnel that perform exposure monitoring with this procedure are responsible to follow all steps in this procedure.

2.3 The data collected using this meter must have an appropriate evaluation of the hazard and risk by a skilled Industrial Hygiene professional.

3.0 Definitions See IH procedure 99150

4.0 Prerequisites

4.1 **Training prior to using this meter:**

4.1.1 Demonstration of proper operation of the instrument to the satisfaction of the employee's supervision.

4.1.2 Review of the Radio Frequency /Microwave ESH Standard 2.3.2.

4.2 **Area Access**:

4.2.1 Contact the appropriate Facility Support Representative or FS Technician to obtain approval to enter radiological areas. Complete appropriate training for the area to be entered.

4.2.2 Verify with the appropriate Facility Support Representative or FS Technician if a Work Permit or Radiological Permit is needed or is in effect. If so, review and sign the permit.

4.2.3 Use appropriate PPE for area.

5.0 Precautions

5.1 Hazard Determination:

5.1.1 The operation of an area survey meter does not create exposure to any chemical, physical, or radiological hazards. The meters do not generate Hazardous Waste.

5.1.2 The meter design does not cause significant ergonomic concerns in routine use.

5.1.3 The meter is sensitive and can be burned by entry into fields above their capacity. Approach the source from a low background.

5.1.4 The primary hazards from rf/microwave is heating of the body. The eyes and genitals/reproductive organs are the most sensitive. Prolonged exposure to very high sources can result in death to the individual.

5.1.5 High standing waves – In high field areas with high standing waves or high reflections, high currents may be induced in the probe cable and handle. In such areas, it may be advisable to use a resistive cable such as are provided in the Holaday Industries extension cables.

5.2 Personal Protective Equipment:

5.2.1 If high fields are expected, the NARDA Alert alarming meter can be used to alarm in high fields.

5.2.2 Rf /microwave protective clothing is not available. Rely on engineering and administrative controls such as remaining a safe distance from the source as indicated by this direct reading meter.

5.2.3 Additional PPE: Other appropriate PPE for hands, feet, skin, head, or eyes may be needed for the area being entered. Check with the area FS Representative.

5.3 Interferences

5.3.1 It is important that you know the frequencies of concern. The meter may read falsely high.

5.3.2 If there are interferences, such as a CRT in the 15-100 KHz range, that may induce voltages into the detection system via feed lines rather than antennas, and hence it is impossible to correlate the reading of the instrument with a meaningful calibration. The same may be said about the case where measurements are attempted in the presence of high 60Hz fields such as would be found under very high voltage transmission lines.

5.3.3 When pulses are very short and repetitive (1-2 seconds), such as at the LINAC, this is not the instrument will display pulse in the reading that cannot be quantified.

6.0 Procedure

6.1 Follow the decision logic and monitoring strategy outlined on IH 99150.

- Determine the duration of the pulse and the number of repetitions per time (sec; min, etc.) of the source.
- Determine if the range of the source is within the range of the equipment:
  - Electric probe STE - range 0.5 MHz to 6000 MHz (500kHz to 6 GHz)

- (Magnetic probe CH– range 0.5 to 300 MHz (500 kHz to 300 MHz)
- (Magnetic probe LFH– range 0.5 to 10 MHz magnetic.

Follow the decision logic in the flow chart in IH99150.

- Start with the E field measurement.
- If the frequency is less than 300 MHz, an H field measurement is required.
- If the frequency is less than 100 MHz and the time and spatially averaged E field (measured as a percentage of the TLV) is greater than the ACGIH (BNL) OEL, then make induced or contact current measurements using the Holaday HI–3702 Clamp on Induced Current Meter; HI4416 System readout.

6.2 **Calibration:** Determine if the probes are in calibration, as per SOP IH51660. The meter can only be factory calibrated.

6.3 **Check the battery:** The "Battery" indicator LED will blink when the unit is turned on and the batteries are good. When the battery voltage drops below a safe operating level, the LED will light steadily and will not blink. The battery pack will provide approximately 30 hours of continuous use or up to 40 hours of intermittent use.

6.4 Operating instructions

6.4.1 Insert a probe into the handle and, with light pressure, rotate the probe until the alignment marks meet and the keyway is felt; then fully seat the probe in the handle connector. Secure the probe in the handle by tightening the locking collar.

6.4.2 Turn the selector switch to the desired range. The probes are color-coded and correspond to the colored scale multipliers selected by the range selector switch on the front panel.

6.4.3 Zeroing: There is no zero adjust since the unit has automatic, full-time self zeroing capability Move the PEAK HOLD switch to the left to clear the memory.

6.4.4 Peak Hold: The memory is active any time the instrument is on. It is continually being updated with the highest reading observed since the last switch operation. Activating the PEAK HOLD switch indicates the highest reading, then releasing the switch automatically clears and zeros the memory. Since a time-averaged signal is important in making safety measurements, the actual meter indication or recorder output will usually provide a more suitable reading.

6.4.5 The "OVER RANGE" LED will light if the following conditions occur if the integrated signal is greater than full scale. In the event of any over range condition switch to the next higher range. The meter will automatically re-zero.

6.4.6 Audible Alarm: The unit can support a headset through which the operator can hear an audible "Geiger" type clicking and alarm whenever an over range condition occurs.

6.5 Taking Measurements

6.5.1 **Operator Position:** Preferably the operator should be further from the source than the probe. Hold the probe at arms length, not close to the body. Approach source, taking reading from a low background. Make sure the probe does not get overloaded. Overloading will result in burning out the probe.

6.5.2 Keep the probe away from reflective surfaces.

6.5.3 **Low Frequency Measurements:** When measuring electric fields, at frequencies below approximately 3MHz.: minimize unwanted pickup by placing the probe handle perpendicular to the field orientation and carefully coiling the probe cord. Keep the probe away from the body or any object that could cause reflections or radiation to be picked up by the probe. The meter can be placed on a non-conducting support, such as a wooden stepladder or stand. Back away from the instrument until the reading stabilizes. The meter scale is easily read from several feet away.

6.5.4 Spatially averaged levels are needed when:

- Specified in an Occupational Exposure Limits (OEL). For compliance with the ACGIH (BNL) standard – the average of a series or ten field strength measurements is performed in a vertical line with uniform spacing starting at ground level up to a height of 2 m (~6 feet 8 inches) separated by 20 cm (about 8 inches).
- In exposure situations where the distribution of field strengths is substantially nonuniform over the body, for frequencies less than 300 MHz. Determine the spatial average of the exposure fields over the plane occupied by the body.
- When nonuniform fields are encountered in reflective conditions such as standing wave fields produced by reflection of fields from the earth or other reflective surfaces.

6.5.5 Take measurements at the employee's level (whether sitting, standing or bending) to estimate personal exposures and to locate isometric lines of RF field intensity on a sketch for defining area levels.

6.5.6 Measurements should be taken at least 8 inches away from the surface of the source.

6.6 Units of Measure

6.6.1 The instrument displays in $|FSU|^2$ which means field strength units squared. When using an E- field probe, the units are V^2/m^2 and when using an H-field probe, the units are in A^2/m^2.

In the near-field region, both the E and H field strength vary greatly with small changes in distance. Each must be measured independently.

6.7 **Recording readings:**

6.7.1 Use a Direct Reading Sampling Instrument Form o*r equivalent* to record readings and additional required information.

6.7.2 Return meter and original sampling form to the SHSD IH Laboratory.

6.7.3 Ensure that a copy of any hazard evaluation report written by a competent person on the survey is sent to the IH Laboratory and the Occupational Medicine Clinic, the department ESH coordinator, and the individuals surveyed.

6.8 Calculations

6.8.1 If the spatially averaged mode is not used, average the values across the vertical range (take the square root of the average of the squares of the values of the vertical range) or visually identify the highest value as the worst-case incident.

6.8.2 If values are greater than or equal to 50% of the standard, then individuals are referred to the occupational medicine clinic for inclusion in the RF protocol. Further review should be made to determine what additional controls or procedures should be instituted.

7.0 References

7.1 ACGIH Documentation of TLVs. American Conference of Governmental Industrial Hygienists.

7.2 ESH Standard 2.3.2 RF and Microwaves

7.3 Holaday Industries, Inc. HI-3000 series Broadband Isotropic Field Strength Meter Owner's Manual. Copyright 1991.

8.0 Attachments

8.1 Photo of parts
8.2 Probe Specifications

9.0 Documentation

Document Review Tracking Sheet		
PREPARED BY: *(Signature and date on file)* **N. M. Bernholc** **SHSD IH Group** **Date 01/22/02**	**REVIEWED BY:** *(Signature and date on file)* **J. Peters** **SHSD IH Group** **Date 02/05/02**	**APPROVED BY:** *(Signature and date on file)* **R. Selvey** **SHSD IH Group Leader** **Date 02/11/02**
Filing Code: **IH51QR.02**	**DQAR** **Date**	**Effective Date:** **02/11/02**

Periodic Review Record		
Date of Review	Reviewer Signature and Date	Comments Attached

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER **IH99280**
	REVISION **FINAL rev0**
SUBJECT: GENERAL PRINCIPLES: **Holaday HI-3002 Electromagnetic Broadband Exposure Meter**	DATE **02/11/02**
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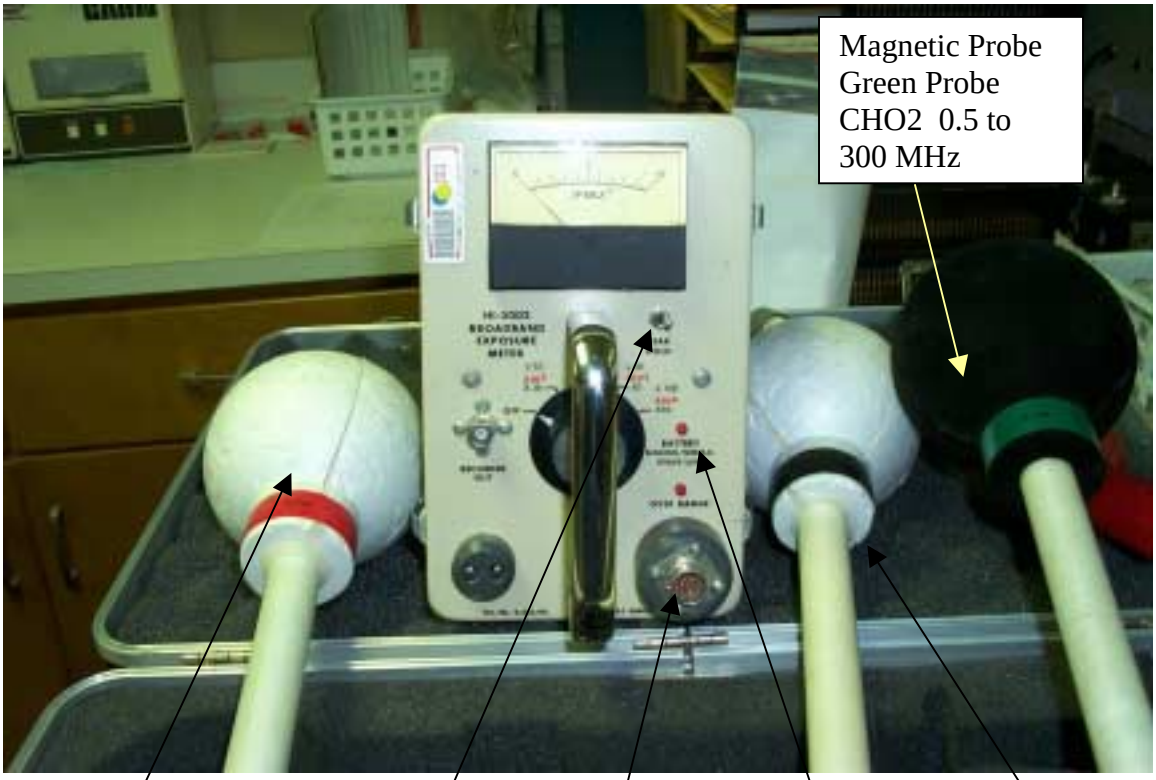
Attachment 8.1a
Photo of the Meter



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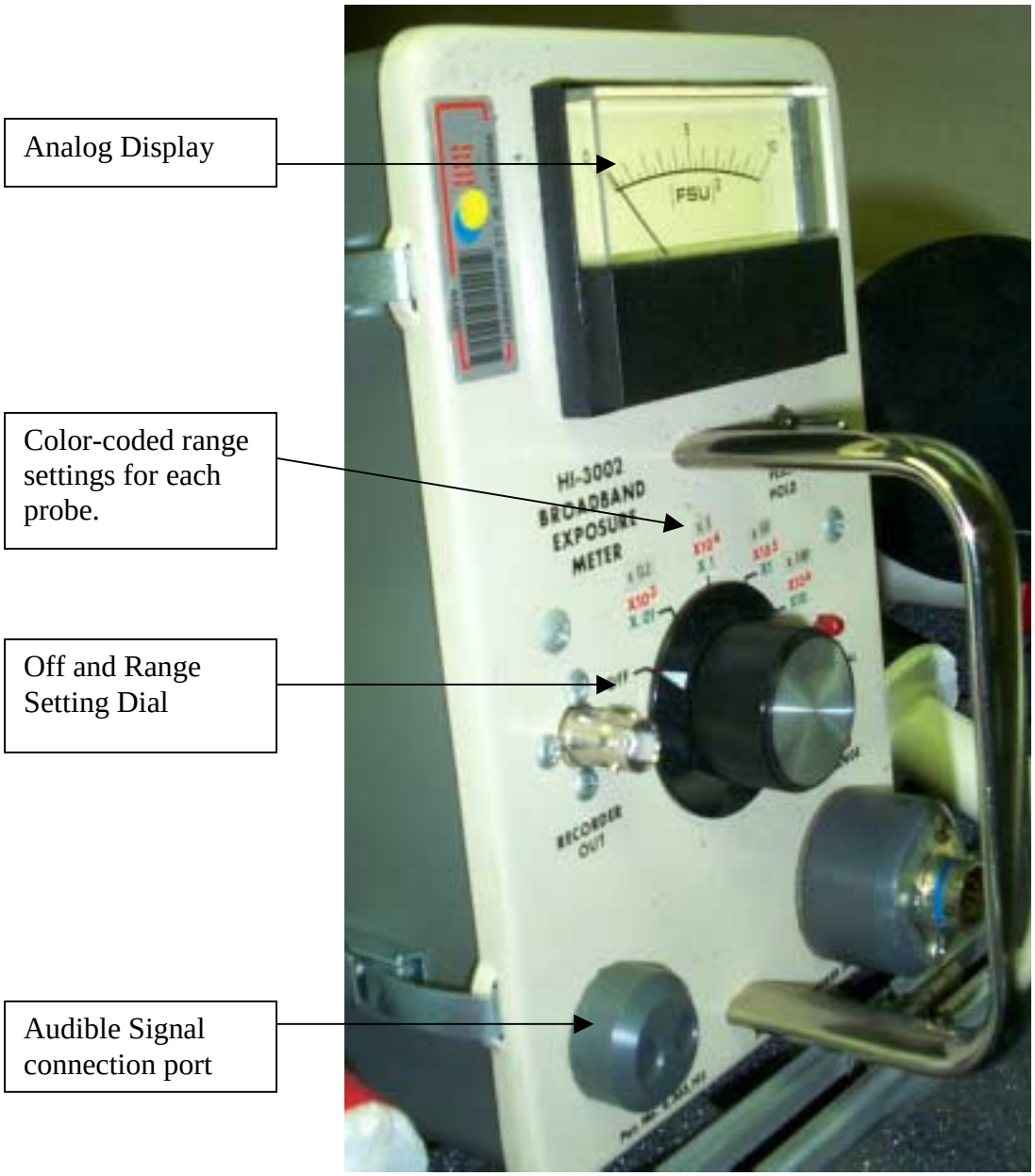
Attachment 8.1b

Photo of the Meter



Attachment 8.2
Probe Specifications

	Probe Range MHz	Scale	Reading range |FSU|	Equivalent maximum Power Density (mW/cm^2)
STE Red	5 – 6000		(v^2/m^2)	
		1	10^4	2.65
Electric Field Probe		2	10^5	26.5
		3	10^6	265
		4	10^7	2653
CH Green	5 – 300		(a^2/m^2)	
		1	0.1	3.77
Magnetic Field Probe		2	1	37.7
		3	10	377
		4	100	3770
LFH Black	.3 to 10		(a^2/m^2)	
		1	1	37.7
Magnetic Field Probe		2	10	377
		3	100	3770
		4	1000	37700